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Isotope Separation Using Single-Photon Atomic Sorting MELISSA JERKINS, ISAAC CHAVEZ, MARK RAIZEN, University of Texas at Austin —
Isotope separation is one of the grand challenges of modern society and holds great potential for basic science, medicine, energy, and defense. We present a new and general approach to isotope separation. The method is based on an irreversible change of the mass-to-magnetic moment ratio of a particular isotope in an atomic beam, followed by deflection in a magnetic field gradient. We numerically simulate isotope separation for a range of examples. The first class of atoms we consider are those that have zero magnetic moment in their ground electronic state. A laser induces an irreversible transition to a metastable state, followed by magnetic deflection. The second (larger) class of atoms we consider are those that have a magnetic moment in their ground state. The magnetic stretch-state is deflected in one zone of a magnetic field gradient, followed by a laser excitation that lowers the magnetic moment of a particular isotope. Those atoms are then separated in a second field gradient zone. We show that the efficiency of the process is only limited by the available laser power, since one photon on average enables the separation of one atom.

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